In recent years, many religious scientists, among them, have written at length about the emerging harmony between the discoveries of modern science and the Torah account of Creation. In particular, the big bang theory of cosmology provides a scientific explanation for every word and phrase that appears in the first five verses of Bereishit—the First Day of Creation. In view of these remarkable correlations between Torah and science, it is tempting to explore the other traditional source that discusses the creation of the universe, namely, kabbalah.
Kabbalah presents a description of Creation that is very different from the description that appears in the first chapter of Bereishit. This does not imply any contradiction between these two accounts of the same event. Rather, the two versions emphasize different features. The Torah description deals with the actual sequence of events (First Day, Second Day, et cetera), whereas kabbalah stresses the role of God in the process of Creation and His interactions with the universe.

It is possible that the account of Creation given by kabbalah can be correlated with the findings of modern science. One might object to this question on the grounds that kabbalah deals with the spiritual realm, whereas science is restricted to the physical realm. Nevertheless, one of the principles of kabbalah is that the spiritual realm of the world above descends, suitably garbed, to create a physical counterpart in the world below. Therefore, it is indeed in place to ask: Can one find features of the physical world that appear related to kabbalah? As we shall see, the answer is “yes.”

In the past few decades, the physical universe has been revealed to be a far richer, stranger and more wonderful place than anyone could have imagined. It is precisely this subtlety and intricacy of the physical world that provide the framework for the various correlations with the spiritual world of kabbalah.

Kabbalah

There are learned scholars who have spent their entire lives studying the mysteries of kabbalah. It is therefore obvious that this essay will not contain a comprehensive account of the subject. For our purposes, it is sufficient to concentrate on a few basic principles. It should be noted that there are different traditions in kabbalah. Our presentation will follow the ideas of the Ari (Rav Isaac Luria, sixteenth century), whose approach to kabbalah was foreshadowed in the writings of earlier mekhulalim (kabbalists). The Viewers of the Ari were written down by his most important disciple, Rav Chaim Vital.

One of the basic concepts in kabbalah is the sefirot. The origin of the term has been understood in various ways: it is either sefira, that is, “spheres,” or sapirim, relating to God’s “radiating and sparkling,” or meqaprim, alluding to the Divine light. The nature and development of this light is dealt with in kabbalistic literature. What is relevant to our discussion is the discussion of the light on the sefirot or, more accurately, on the vessels (kabolot) associated with each of the ten sefirot.

The vessels of the first three sefirot managed to contain the ray of light that flowed into them. However, as the light gradually increased, it was too powerful to be held by their vessels, which cracked and shattered, one after another. This kabbalistic concept is known as “the breaking of the vessels.” Before the universe was created, the Divine light of kabbalah managed to contain the ray of light. In the future, through human fulfillment of Torah and mitzvot, the seven broken sefirot may regain their perfection, a process known as tikkun. However, until then, the universe will consist of three intact and seven broken sefirot.

The Kabbalistic Account of Creation

Kabbalah characterizes God as the Ein-Sof (“without end”), a limitless and unknowable infinite realm. The ten sefirot are configurations of Divine powers within the Godhead, containing the principles whereby God manifests Himself to us, and constituting the vehicle through which God interacts with the universe.

In the beginning, the universe did not exist. The existence of an entity in addition to the Ein-Sof would have been impossible, because this would constitute a limitation on infinity.

The Scientific Account of Creation

The branch of science that deals with the origin of the universe is known as cosmology. In every age and in every culture, people would look up at the sky and wonder: What was the origin of the heavenly bodies—the sun, the moon and the stars? The concept of Creation was considered an impossibility, because science asserted that something cannot come from nothing. Therefore, scientists viewed the universe as eternal, thus nearly avoiding questions regarding its origin.

The Kabbalistic Account states that the universe was created “by withdrawing.” Although the Midrash also speaks of the presence of God undergoing tzimtzum, the idea there is that His presence contracts and concentrates into a point. The Ari understood tzimtzum to mean contracting and withdrawing away from a point. This Divine withdrawal made possible the creative processes leading to an entity—the universe—that could exist in parallel with the Ein-Sof.

God’s withdrawal provided a space into which flowed a ray (kar) of Divine light. The nature and development of this light is dealt with in kabbalistic literature. What is relevant to our discussion is the discussion of the light on the sefirot or, more accurately, on the vessels (kabolot) associated with each of the ten sefirot.

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To enable the universe to exist required an act of tzimtzum on the part of God. The literal meaning of tzimtzum is “contraction.” Consequently, the ARI understood tzimtzum as “withdrawal.” Nonetheless, one of the principles of kabbalah is that the spiritual realm of the world above descends, suitably garbed, to create a physical counterpart in the world below. Therefore, it is indeed in place to ask: Can one find features of the physical world that appear related to kabbalah? As we shall see, the answer is “yes.”

In the past few decades, the physical universe has been revealed to be a far richer, stranger and more wonderful place than anyone could have imagined. It is precisely this subtlety and intricacy of the physical world that provide the framework for the various correlations with the spiritual world of kabbalah.

Today, it is hardly possible to carry on a meaningful discussion of cosmology without the creation of the universe assuming a central role. The second and third features of the kabbalistic account of Creation with entities—the Divine light and the ten sefirot—follow. According to kabbalah, as stated previously, every entity of the spiritual world above descends, suitably garbed, into the physical realm of the world below. Therefore, the physical counterparts to the Divine light and the ten sefirot are to be sought in the world below.

The physical counterpart of the Divine light of kabbalah is the primordial light of the big bang. The standard theory of cosmology asserts that the entity that was created at the beginning of time was an enormous ball of light, popularly known as the big bang and hence, the name of the theory. With appropriate instrumenta-

Comparing Kabbalah with Science

Let us summarize the three features of the kabbalistic account of Creation: 1. the universe began through an act of Creation; 2. the universe was created by an entity known as Ein-Sof; 3. the universe was created from nothing.

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The Scientific Account of Creation

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Gravity

To understand why scientists speak of a ten-dimensional universe, one must study gravity. Over the years, the theory of gravity has undergone a number of important changes, which we shall now describe.

In 1687, the first theory of gravity was proposed by Sir Isaac Newton. In his Principia, the most important book of science ever written, Newton introduced the idea that every two objects in the universe attract each other with a force, called gravity, whose magnitude depends on the distance between the objects. This proposal enabled Newton to explain planetary motion, as well as many other phenomena, such as the tides.

Gravity is one of the four forces in nature. The other forces are the two nuclear forces (that operate within the atomic nucleus) and the electric force (or, more correctly, electromagnetic force, since electricity and magnetism are two aspects of the same force). In 1905, Albert Einstein proposed the special theory of relativity, establishing the relationship between matter (M) and energy (E) through his famous formula, \( E=MC^2 \), where the letter c refers to the speed of light.

Einstein’s theory of special relativity has been confirmed countless times and is one of the fundamental principles of science. Every scientific theory must be compared with the theory of special relativity. The theories of the nuclear forces and the electric force were found to be consistent with special relativity.

However, Newton’s theory of gravity did not conform to the principles of relativity. It took Einstein a decade to formulate a new theory of gravity that was consistent with special relativity. In 1916, Einstein announced his theory of gravity, which he called the “general theory of relativity,” considered by leading scientists to be “the most beautiful of all existing physical theories.”

3. The most surprising result of Einstein’s theory is that gravity is not a force, but rather, it is a “distortion of space.”16 The gravitational attraction between two objects is not due to one object pulling on the other object, as is the case for the electric force between two electric charges. Instead, gravity works as follows: The first object “distorts” the space around it, and the second object moves in reaction to this distortion of space. Since we cannot see the distortion of space, it appears as though the two objects are attracted to each other as means of a force.

This concept can best be explained by means of the illustration in Figure 1. In the top part of the figure, one sees a stretched rubber sheet on which a small ball lies motionless. The bottom part of the figure shows what occurs after a large ball has been placed on the rubber sheet. The effect of the large ball is to distort the rubber sheet, with the distortion being greatest in the vicinity of the large ball but much lesser further away.

As a result of the distortion of the rubber sheet, the small ball begins to move toward the point of maximum distortion (which is where the large ball lies). Therefore, the small ball moves toward the large ball. However, there is no force of attraction between the two balls. The motion of the small ball is caused by the distortion of the rubber sheet, which in turn is caused by the large ball.

The rubber sheet represents space whose “dimension” is invisible to us. We see only the small ball moving toward the large ball. Therefore, Newton assumed that a force of attraction (gravity) exists between every pair of masses. However, Einstein’s theory con- strated that gravity is not a force at all, and that the correct description of gravity is a distortion of space.

The theories of gravity proposed by Einstein and by Newton are fundamentally different. In practice, howev- er, the predictions of these two theories are very similar. In fact, their predictions agree with each other for certain phenomena.

Therefore, Einstein’s theory of gravity has become accepted by all scientists. In summary, gravity is not a force, but rather a distortion of space. Thus, gravity is a manifestation of the three forces of nature. We shall soon see the importance of this.

4. The 1920s witnessed the development of quantum theory. The revolu- tionary aim of this new theory was to describe the behavior of the universe at the quantum level. The basic entities of the universe are particles—electron, quark, photon, etcetera. String theory asserts that the basic entities of the universe are tiny strings.

These strings can vibrate (like a violin string), and the energy of vibration appears as a parti- cle through the Einstein relation between energy and mass (E=MC^2). If another string theory does make a prediction, it can be consistent with three-dimensional universe, nothing is gained. In three dimensions, string theory fails to yield a theory of quantum gravity. Moreover, a similar failure would occur for any many Richard P. Feynman, QED: The Strange Theory of Light and Matter [New Jersey, 1998].

Quantum theory has been confirmed by thousands of experiments, and it has become established as a basic principle of science. Every correct the- ory must be compatible with quantum theory. Feynman received a Nobel prize for devising the procedure, called “renormalization,” that makes the the- ory of the electric force compatible with quantum theory. Feynman’s procedure also succeeds for the nuclear forces. However, when scientists applied Feynman’s procedure to Einstein’s theory of gravity, the results were meaningless.17 This failure was shown to be due to the fact that gravi- ty is not a force, but rather a distortion of space. It is this feature that makes Einstein’s theory of gravity incompatible with quantum theory.

This is a very serious problem indeed. Quantum theory is certainly correct, and Einstein’s theory of gravity is also certainly correct. How can it be that two correct theories of nature cannot be made compatible with each other? Why is it impossible to formulate a consistent theory of “quantum gravity”?

5. The apparent contradiction between quantum theory and Einstein’s theory of gravity is resolved by string theory. (An excellent layman exposition of string theory has been given to us by the string theorist Brian Greene in The Elegant Universe.)

String theory is a new conceptual framework for describing the physical universe. According to this conception, the basic entities of the universe are particles—electron, quark, photon, etcetera. String theory asserts that the basic entities of the universe are tiny strings. These strings can vibrate (like a violin string), and the energy of vibration appears as a particle through the Einstein relation between energy and mass (E=MC^2). If another string theory does make a prediction, it can be consistent with the three-dimensional universe, nothing is gained. In three dimensions, string theory fails to yield a theory of quantum gravity. Moreover, a similar failure would occur for any many Richard P. Feynman, QED: The Strange Theory of Light and Matter [New Jersey, 1998].

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String theory is the modern scientific framework for understanding the universe. One of the most important discoveries of string theory is that we inhabit a ten-dimensional universe. Of these ten dimensions, three are the familiar dimensions of space, while the remaining seven became compacted during the process of Creation and, as a result, "we are unable to perceive the full ten-dimensional glory of space."  

Kabbalah, Science and Creation—A Summary

String theory is the modern scientific framework for understanding the universe. One of the most important discoveries of string theory is that we inhabit a ten-dimensional universe. Of these ten dimensions, three are the familiar dimensions of space, while the remaining seven became compacted during the process of Creation and, as a result, "we are unable to perceive the full ten-dimensional glory of space."  

Kabbalah, which describes the spiritual world above, speaks of ten sefirot. Of these ten sefirot, three remain intact while the other seven became broken during the process of Creation. The ten-dimensional universe of the world below is to be identified as the physical counterpart of the ten sefirot of the world above. Similarly, the seven compacted dimensions of the world below are the physical counterpart of the seven broken sefirot of the world above. The world above and the world below are, respectively, the spiritual and physical expressions of the universe.

The world above was happy, and the world below rejoiced when the Torah was received on Mount Sinai (Vetzros of Shavuot, Musaf of the first day).

One of these indirect effects is that the compacted dimensions lead to a consistent theory of quantum gravity.  

Notes


2. See, for example, Aviezer, In the Beginning, chap. 1.

3. This statement relates to Torah words that have physical content. However, there are also Torah words in the first chapter of Bereishit that have only spiritual content, such as, "The spirit of God hovered over the surface of the water" (1:2). Clearly, science can tell us nothing about the meaning of this Torah phrase.

4. Sefer Etz Chaim.

5. Ibid., heichal aleph (adam hadamah), sha’ar aleph, drush iggulim veyosher.

6. There are four major pieces of evidence: 1. The discovery of the remnant of the initial ball of light that fills the universe; 2. The hydrogen-to-helium ratio in the universe; 3. The expansion of the galaxies and 4. The perfect black-body spectrum of the microwave background radiation measured by the COBE space satellite in 1990, and the additional measurements of this radiation made by the MAP space satellite launched in 2001.


8. The Elegant Universe (Landon, 1999), 345-346.


10. The Large Scale Structure of Space-Time (Cambridge, United Kingdom, 1973), 364.

11. Scientists often use the term "electromagnetic radiation," which means the same thing as light. To avoid technical terminology, we use the word light.

12. String theory has gone by a variety of names during its development, including superstring theory, brane theory and M-theory, with the last designation being popular among the cognoscenti. Here we shall use the more widely known name of “string theory,” even though we shall be quoting the latest results of M-theory.


14. Einstein’s theory of special relativity asserts that space and time are interwoven, and one therefore speaks of space-time. However, we shall restrict our discussion to spatial dimensions. The concept of time in kabbalah is a subject that requires a separate article.


16. Einstein’s theory of gravity also implies a distortion of time (called time dilation) since time is linked to space. However, we will not be discussing time here.

17. The calculated value for many measurable quantities was found to be infinity. Also, the theory had internal inconsistencies.

18. String theory also yields a consistent theory of quantum gravity for a universe having twenty-six dimensions, and for a universe having an even higher number of dimensions. However, scientists concentrate on the lowest number of dimensions (ten), for which there exists a consistent theory of quantum gravity.


20. Another important effect of the compacted dimensions concerns the magnitude of the forces of nature. At normal (low) energies, the magnitude of the forces ranges from the very strong nuclear force to the very weak force of gravity. At a specific very high energy, called the Planck energy, it has been shown that all the forces of nature must have the same magnitude. Calculations show that this prediction is correct only if the universe has additional compacted dimensions.

21. Veneziano, 43.